IN THE CLAIMS

1. (Currently Amended) A demodulator, comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals; and

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that ~~transit~~ transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information.

2. (Currently Amended) The demodulator according to claim 1, ~~characterized in that~~ wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase ~~composing~~ of a first state having a minimum~~/maximum~~ or a maximum survival path metric on the trellis diagram is hard decision data, and

a difference between (1) a survival path metric that ~~transit~~ transits into ~~a~~ the first state having a minimum~~/maximum~~ or maximum survival path metric, and ~~one~~ (2) a survival path metric that ~~transit~~ transits into ~~another~~ a second state in which ~~has~~ a minimum~~/maximum~~ or a maximum survival path metric in the states ~~composed the~~ of differential phase corresponding

to ~~the~~ bits obtained by inverting the hard decision data are used as components, is defined as reliability information of the hard decision data~~;~~

~~the soft decision demodulated data are generated according to the hard decision data and the reliability information~~.

3. (Currently Amended) A demodulator, comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal; and

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that ~~transit~~ transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information.

4. (Currently Amended) The demodulator according to claim 3, wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase ~~composing~~ of a first state having a minimum~~/maximum~~ or a maximum survival path metric on the trellis diagram is hard decision data, and

a difference between (1) a survival path metric that ~~transit~~ transits into ~~a~~ the first state having a minimum~~/maximum~~ or a maximum survival path metric, and (2) ~~one~~ a survival path metric that ~~transit~~ transits into ~~another~~ a second state in which ~~has~~ a minimum~~/maximum~~ or a maximum survival path metric in the states ~~composed the~~ of differential phase corresponding to ~~the~~ bits obtained by inverting the hard decision data are used as components, is multiplied by the detected power so that the multiplied result is defined as reliability information of the hard decision data~~,~~

~~the soft decision demodulated data are generated according to the hard decision data and the reliability information~~.

5. (Currently Amended): A demodulator, comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a ρ-multiplying unit ~~which multiplies~~ configured to multiply the detected power by a predetermined number ρ; and

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ-multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information.

6. (Currently Amended) The demodulator according to claim 5, wherein, in said soft decision demodulated data estimating unit,

a bit corresponding to the differential phase ~~composing~~ of a first state having a minimum~~/maximum~~ or a maximum survival path metric on the trellis diagram is hard decision data, and

a difference between (1) a survival path metric that ~~transit~~ transits into ~~a~~ the first state having a minimum~~/maximum~~ or a maximum survival path metric, and (2) ~~the one~~ a survival path metric that ~~transit~~ transits into ~~another~~ a second state in which ~~has~~ a minimum~~/maximum~~ or a maximum survival path metric in the states ~~composed the~~ of differential phase corresponding to ~~the~~ bits obtained by inverting the hard decision data are used as components, is multiplied by the ρ-multiplied value of the detected power so that the multiplied result is reliability information of the hard decision data~~,~~

~~the soft decision demodulated data are generated according to the hard decision data and the reliability information~~.

7. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of

differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

8. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output the calculated results as 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

~~an interleaving~~ a deinterleaving unit configured to deinterleave ~~which interleaves~~ the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the ~~interleaving~~ deinterleaving.

9. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

10. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

~~an interleaving~~ a deinterleaving unit ~~which interleaves~~ configured to deinterleave the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the ~~interleaving~~ deinterleaving.

11. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a ρ-multiplying unit ~~which multiplies~~ configured to multiply the detected power by a predetermined number ρ;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ-multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

12. (Currently Amended) A receiver ~~which~~ that receives data from a transmitter, said receiver comprising:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect a power of the received signal;

a ρ-multiplying unit ~~which multiplies~~ configured to multiply the detected power by a predetermined number ρ;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to

estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ-multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

~~an interleaving~~ a deinterleaving unit ~~which interleaves~~ configured to deinterleave the soft decision demodulated data according to a predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the deinterleaving ~~interleaving~~.

13. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises: ~~including having,~~

a convolutional coding unit ~~which~~ configured to convolutional ~~encodes~~ encode the transmitted data;

a converting unit ~~which converts~~ configured to convert the convolutional-coded data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ encode the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/output unit ~~which generates/outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises: ~~including having,~~

a multiple differential phase detection signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1,

2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

14. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter comprises: ~~including having,~~

a convolutional coding unit ~~which~~ configured to convolutional ~~encodes~~ encode the transmitted ~~of the~~ data;

~~a first~~ an interleaving unit ~~which interleaves~~ configured to interleave an order of the convolutional-coded data according to a predetermined algorithm;

a converting unit ~~which converts~~ configured to convert the interleaved data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/ output unit ~~which generates /outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver comprises: ~~including having,~~

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence and a survival path metric that transits into each state on the trellis diagram,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a ~~second interleaving~~ deinterleaving unit ~~which interleaves~~ configured to deinterleave the soft decision demodulated data according to ~~a~~ the predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the ~~interleaving~~ deinterleaving.

15. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter ~~having,~~ comprises:

a convolutional coding unit ~~which performs~~ configured to convolutional ~~encodes~~ encode the transmitted ~~of the~~ data;

a converting unit ~~which converts~~ configured to convert the convolutional-coded data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ encode the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/ output unit ~~which generates /outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver ~~having,~~ comprises:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

16. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter ~~having,~~ comprises:

a convolutional coding unit ~~which~~ configured to convolutional ~~encodes~~ encode the transmitted data;

~~a first~~ an interleaving unit ~~which interleaves~~ configured to interleave an order of the convolutional-coded data according to a predetermined algorithm;

a converting unit ~~which converts~~ configured to convert the interleaved data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ encode the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/ output unit ~~which generates /outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver ~~having,~~ comprises:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ configured to estimate soft decision demodulated data according to the estimated transmitted

differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a ~~second interleaving~~ deinterleaving unit ~~which interleaves~~ configured to deinterleave the soft decision demodulated data according to ~~a~~ the predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the ~~interleaving~~ deinterleaving.

17. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter ~~having,~~ comprises:

a convolutional coding unit ~~which performs~~ configured to convolutional ~~encodes~~ encode the transmitted data;

a converting unit ~~which converts~~ configured to convert the convolutional-coded data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ encode the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/ output unit ~~which generates/ outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver ~~having,~~ comprises:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a ρ-multiplying unit ~~which multiplies~~ configured to multiply the detected power by a predetermined number ρ;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate a transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ-multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data.

18. (Currently Amended) A communication system comprising a transmitter for transmitting a data and a receiver for receiving the data, wherein

said transmitter ~~having,~~ comprises:

a convolutional coding unit ~~which~~ configured to convolutional ~~encodes~~ encode the transmitted data;

~~a first~~ an interleaving unit ~~which interleaves~~ configured to interleave an order of the convolutional-coded data according to a predetermined algorithm;

a converting unit ~~which converts~~ configured to convert the interleaved data into a transmission differential phase;

a differential coding unit ~~which~~ configured to differential ~~encodes~~ encode the transmission differential phase and ~~maps~~ to map the differential encoded data to the signal phases; and

a transmission signal generation/ output unit ~~which generates /outputs~~ configured to generate/output a differential phase modulated signal based on the transmission signal phase,

said receiver ~~having,~~ comprises:

a multiple differential phase detected signal output unit ~~which calculates~~ configured to calculate phase differences between a received signal and previously received signals of 1, 2, ..., N symbols (~~Where~~ where N is an integer greater than 2) ~~symbols before~~ so as to output ~~the calculated results as~~ 1, 2, ..., N symbol differential phase detected signals;

a power detection unit ~~which detects~~ configured to detect power of the received signal;

a ρ-multiplying unit ~~which multiplies~~ configured to multiply the detected power by a predetermined number ρ;

a soft decision demodulated data estimating unit ~~which estimates~~ configured to estimate transmitted differential phase sequence according to the 1, 2, ..., N symbol differential phase detected signals using a trellis diagram representing transitions of differential phase states of transmitted signals and a Viterbi algorithm, and ~~estimates~~ to estimate soft decision demodulated data according to the estimated transmitted differential phase sequence, a survival path metric that transits into each state on the trellis diagram, and the ρ-multiplied value of the detected power,

wherein the soft decision demodulated data are estimated as the product of hard decision data and reliability information; and

a ~~second interleaving~~ deinterleaving unit ~~which interleaves~~ configured to deinterleave the soft decision demodulated data according to ~~a~~ the predetermined algorithm; and

a decoding unit ~~which decodes~~ configured to decode the original transmitted data based on the soft decision demodulated data after the ~~interleaving~~ deinterleaving.